A Guide to Foreign Exchange Markets

K. Alec Chrystal

THE economies of the free world are becoming increasingly interdependent. U.S. exports now amount to almost 10 percent of Gross National Product. For both Britain and Canada, the figure currently exceeds 25 percent. Imports are about the same size. Trade of this magnitude would not be possible without the ability to buy and sell currencies. Currencies must be bought and sold because the acceptable means of payment in other countries is not the U.S. dollar. As a result, importers, exporters, travel agents, tourists and many others with overseas business must change dollars into foreign currency and/or the reverse.

The trading of currencies takes place in foreign exchange markets whose major function is to facilitate international trade and investment. Foreign exchange markets, however, are shrouded in mystery. One reason for this is that a considerable amount of foreign exchange market activity does not appear to be related directly to the needs of international trade and investment.

The purpose of this paper is to explain how these markets work.[1] The basics of foreign exchange will first be described. This will be followed by a discussion of some of the more important activities of market participants. Finally, there will be an introduction to the analysis of a new feature of exchange markets — currency options. The concern of this paper is with the structure and mechanics of foreign exchange markets, not with the determinants of exchange rates themselves.

THE BASICS OF FOREIGN EXCHANGE MARKETS

There is an almost bewildering variety of foreign exchange markets. Spot markets and forward markets abound in a number of currencies. In addition, there are diverse prices quoted for these currencies. This section attempts to bring order to this seeming disarray.

Spot, Forward, Bid, Ask

Virtually every major newspaper, such as the *Wall Street Journal* or the *London Financial Times*, prints a daily list of exchange rates. These are expressed either as the number of units of a particular currency that exchange for one U.S. dollar or as the number of U.S. dollars that exchange for one unit of a particular currency. Sometimes both are listed side by side (see table 1).

For major currencies, up to four different prices typically will be quoted. One is the "spot" price. The others may be "30 days forward," "90 days forward,"

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[1] For further discussion of foreign exchange markets in the United States, see Kubarych (1983). See also Dufey and Giddy (1978) and McKinnon (1979).

Table 1
Foreign Exchange Rate Quotations

Foreign Exchange

Wednesday, September 7, 1983

The New York foreign exchange selling rates below apply to trading among banks in amounts of $1 million and more, as quoted at 3 p.m. Eastern time by Bankers Trust Co. Retail transactions provide fewer units of foreign currency per dollar.

Country	U.S. $ equiv. Wed.	U.S. $ equiv. Tues.	Currency per U.S. $ Wed.	Currency per U.S. $ Tues.
Argentina (Peso)	.09652	.09652	10.36	10.36
Australia (Dollar)	.8772	.8777	1.1340	1.1393
Austria (Schilling)	.05296	.0560	18.88	17.84
Belgium (Franc)				
Commercial rate	.01851	.01855	54.01	53.90
Financial rate	.01844	.01846	54.21	54.15
Brazil (Cruzeiro)	.001459	.00149	685.	671.00
Britain (Pound)	1.4910	1.5000	.6707	.6666
30-Day Forward	1.4915	1.5004	.6704	.6664
90-Day Forward	1.4930	1.5010	.6697	.6662
180-Day Forward	1.4952	1.5028	.6688	.6654
Canada (Dollar)	.8120	.8123	1.2315	.2310
30-Day Forward	.8125	.8128	1.2307	1.2303
90-Day Forward	.8134	.8137	1.2293	1.2289
180-Day Forward	.8145	.8147	1.2277	1.2274
Chile (Official rate)	.01246	.01246	80.21	80.21
China (Yuan)	.50499	.50489	1.9802	1.9806
Colombia (Peso)	.01228	.01228	81.4	81.40
Denmark (Krone)	.10362	.10405	9.65	9.6100
Ecuador (Sucre)				
Official rate	.02082	.02082	48.03	48.03
Floating rate	.010917	.010917	91.60	91.60
Finland (Markka)	.17424	.17485	5.7390	5.7190
France (Franc)	.1238	.1238	8.0750	8.0750
30-Day Forward	.1235	.1230	8.0955	8.1300
90-Day Forward	.1224	.1223	8.1695	8.1725
180-Day Forward	.1203	.1202	8.3100	8.3150
Greece (Drachma)	.01075	.01078	93.	92.70
Hong Kong (Dollar)	.1297	.13089	7.71	7.6400
India (Rupee)	.0980	.0980	10.20	10.20
Indonesia (Rupiah)	.001015	.001015	985.	985.
Ireland (Punt)	1.1715	1.1775	.8536	.8493
Israel (Shekel)	.0173	.0173	57.80	57.80
Italy (Lira)	.000624	.0006255	1602.	1598.50
Japan (Yen)	.004072	.004067	245.55	245.85
30-Day Forward	.004083	.004079	244.88	245.15
90-Day Forward	.004107	.004102	243.48	243.75
180-Day Forward	.004147	.004142	241.10	241.39
Lebanon (Pound)	.20618	.20618	4.85	4.85
Malaysia (Ringgit)	.42462	.42489	2.3550	2.3535
exico (Peso)				
Floating rate	.00665	.00666	150.25	150.00
etherlands (Guilder)	.33288	.3333	3.0040	3.000
ew Zealand (Dollar)	.6497	.6505	1.5397	1.5327
orway (Krone)	.13368	.1340	7.48	7.4625
kistan (Rupee)	.07518	.07518	13.30	13.30
ru (Sol)	.0005105	.0005105	1958.89	1958.89
ilippines (Peso)	.09085	.09085	11.007	11.007
rtugal (Escudo)	.00804	.00807	124.35	123.90
udi Arabia (Riyal)	.28735	.28735	3.48	3.48
ngapore (Dollar)	.46609	.4664	2.1455	2.1440
uth Africa (Rand)	.8870	.8900	1.1273	1.1236
uth Korea (Won)	.001285	.001285	778.20	778.20
ain (Peseta)	.00655	.00658	152.60	151.90
eden (Krona)	.12635	.12666	7.9140	7.8950
itzerland (Franc)	.4596	.4591	2.1755	2.1780
30-Day Forward	.4619	.4615	216.46	2.1666
90-Day Forward	.4662	.4657	2.1449	2.1470
180-Day Forward	.4728	.4723	2.1150	2.1172
wan (Dollar)	.02489	.02489	40.17	40.17
ailand (Baht)	.043459	.043459	23.01	23.01
guay (New Peso)				
Financial	.02798	.02798	35.73	35.73
ezuela (Bolivar)				
Official rate	.23256	.23256	4.30	4.30
Floating rate	.07194	.07272	13.90	13.75
Germany (Mark)	.3726	.3726	2.6835	2.6835
30-Day Forward	.3740	.3741	2.6731	2.6728
90-Day Forward	.3767	.3768	2.6540	2.6538
180-Day Forward	.3808	.3808	2.6260	2.6259
R	1.04637	1.04903	.955685	.953625

Special Drawing Rights are based on exchange rates for the U.S., West German, ish, French and Japanese currencies. Source: International Monetary Fund.

z-Not quoted.

Wall Street Journal, September 8, 1983

The Dollar Spot and Forward

Sept 7	Day's spread	Close	One month	% p.a.	Three months	% p.a.
UK†	1.4860-1.4975	1.4910-1.4920	0.02-0.07c dis	−0.36	0.17-0.22dis	−0.52
Ireland†	1.1665-1.1720	1.1710-1.1720	0.36-0.30c pm	3.39	0.88-0.78 pm	2.84
Canada	1.2305-1.2320	1.2310-1.2315	0.09-0.06c pm	0.73	0.24-0.21 pm	0.73
Nethlnd.	3.0050-3.0150	3.0050-3.0070	1.12-1.02c pm	4.26	3.00-2.90 pm	3.92
Belgium	54.06-54.20	54.06-54.08	7-6c pm	1.44	14-11 pm	0.92
Denmark	9.6400-9.6800	9.6400-9.6450	2-2½ore dis	−2.79	par-½ dis	−0.10
W. Ger.	2.6850-2.6980	2.6865-2.6875	1.07-1.02pf pm	4.66	3.00-2.95 pm	4.42
Portugal	124.20-125.00	124.40-124.70	115-290c dis	−19.51	330-790dis	−17.98
Spain	152.40-152.70	152.50-152.60	170-220c dis	−15.33	675-775dis	−18.99
Italy	1604-1608	1605-1606	10-10½lire dis	−7.65	29½-31 dis	−7.53
Norway	7.4730-7.4940	7.4730-7.4780	1.90-2.20ore dis	−3.29	5.90-6.20ds	−3.23
France	8.0775-8.1225	8.0825-8.0875	2.02-2.12c dis	−3.07	9.65-9.85ds	−4.81
Sweden	7.9120-7.9265	7.9120-7.9170	0.90-1.10ore dis	−1.51	2.25-2.45ds	−1.19
Japan	245.50-246.50	245.65-245.75	0.69-0.64y pm	3.24	2.11-2.03 pm	3.36
Austria	18.89-18.95½	18.89-18.90	7.50-6.70gro pm	4.50	21.00-18.50 pm	4.17
Switz.	2.1770-2.1875	2.1800-2.1810	1.10-1.05c pm	5.91	3.10-3.05 pm	5.63

†UK and Ireland are quoted in U.S. currency. Forward premiums and discounts apply to the U.S. dollar and not to the individual currency.

Belgian rate is for convertible francs. Financial franc 54.40-54.45.

London Financial Times, September 8, 1983 and "180 days forward." These may be expressed either in "European Terms" (such as number of $ per £) or in "American Terms" (such as number of £ per $). (See the glossary for further explanation.)

The spot price is what you must pay to buy currencies for immediate delivery (two working days in the interbank market; over the counter, if you buy bank notes or travelers checks). The forward prices for each currency are what you will have to pay if you sign a contract today to buy that currency on a specific future date (30 days from now, etc.). In this market, you pay for the currency when the contract matures.

Why would anyone buy and sell foreign currency forward? There are some major advantages from having such opportunities available. For example, an exporter who has receipts of foreign currency due at some future date can sell those funds forward now, thereby avoiding all risks associated with subsequent adverse exchange rate changes. Similarly, an importer who will have to pay for a shipment of goods in foreign currency in, say, three months can buy the foreign exchange forward and, again, avoid having to bear the exchange rate risk.

The exchange rates quoted in the financial press (for example, those in table 1) are not the ones individuals would get at a local bank. Unless otherwise specified, the published prices refer to those quoted by banks to other banks for currency deals in excess of $1 million. Even these prices will vary somewhat depending upon whether the bank buys or sells. The difference between the buying and selling price is sometimes known as the "bid-ask spread." The spread partly reflects the banks' costs and profit margins in transactions; however, major banks make their profits more from capital gains than from the spread.[2]

The market for bank notes and travelers checks is quite separate from the interbank foreign exchange market. For smaller currency exchanges, such as an individual going on vacation abroad might make, the spread is greater than in the interbank market. This presumably reflects the larger average costs — including the exchange rate risks that banks face by holding bank notes in denominations too small to be sold in the interbank market — associated with these smaller exchanges. As a result, individuals generally pay a higher price for foreign exchange than those quoted in the newspapers.

Table 2

Dollar Price of Deutschemarks and Sterling at Various Banks

	Deutschemark		Sterling	
	Buy	Sell	Buy	Sell
Retail				
Local (St. Louis) banks (avg.)	.3572–	.3844	1.4225–	1.5025
Wholesale				
New York banks	.3681–	.3683	1.4570–	1.4580
European banks (high)	.3694–	.3696	1.4573–	1.4583
European banks (low)	.3677–	.3678	1.4610–	1.4620
Bankers trust	.3681		1.4588	

Note: These prices were all quoted on November 28, 1983, between 2:00 p.m. and 2:45 p.m. (Central Standard Time). Prices for local banks were acquired by telephoning for their price on a $10,000 transaction. The prices quoted were reference rates and not the final price they would offer on a firm transaction. Figure for Bankers Trust is that given in the *Wall Street Journal*, November 29, 1983, as priced at 2:00 p.m. (Central Standard Time) on November 28, 1983. Other prices were taken from the Telerate information system at 2:35 p.m. New York prices were the latest available (Morgan and Citibank, respectively). European prices were the last prices quoted before close of trading in Europe by various banks. Deutschemark prices were actually quoted in American terms. The sell prices above have been rounded up. The difference between buy and sell prices for DM in the interbank market actually worked out at $0.00015.

An example of the range of spot exchange rates available is presented in table 2, which shows prices for deutschemarks and sterling quoted within a one-hour period on November 28, 1983. There are two important points to notice. First, all except those in the first line are prices quoted in the interbank, or wholesale, market for transactions in excess of $1 million. The sterling prices have a bid-ask spread of only 0.1 cent (which is only about 0.07 percent of the price, or $7 on $10,000). On DM, the spread per dollars worth works out to be about half that on sterling ($4 on $10,000).[3]

Second, the prices quoted by local banks for small, or retail, transactions, which serve only as a guide and do not necessarily represent prices on actual deals, involve a much larger bid-ask spread. These retail spreads vary from bank to bank, but are related to (and larger than) the interbank rates. In some cases, they may be of the order of 4 cents or less on sterling, though the prices quoted in St. Louis involved average spreads of 8 cents on sterling. The latter represents a spread of about 5½ percent (about $550 per $10,000 transaction). The equivalent spread for DM was 7 percent ($700 per $10,000 transaction).

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[2] Notice the *Wall Street Journal* quotes only a bank selling price at a particular time. The *Financial Times* quotes the bid-ask spread and the range over the day.

[3] In practice, the spread will vary during the day, depending upon market conditions. For example, the sterling spread may be as little as 0.01 cents at times and on average is about 0.05 cents. Spreads generally will be larger on less widely traded currencies.

The spread on forward transactions will usually be wider than on spot, especially for longer maturities. For interbank trade, the closing spread on one and three months forward sterling on September 8, 1983, was .15 cents, while the spot spread was .10 cents. This is shown in the top line of the *Financial Times* report in table 1. Of course, like the spot spread, the forward spread varies with time of day and market conditions. At times it may be as low as .02 cents. No information is available for the size of spread on the forward prices typically offered on small transactions, since the retail market on forward transactions is very small.

HOW DOES "THE" FOREIGN EXCHANGE MARKET OPERATE?

It is generally not possible to go to a specific building and "see" the market where prices of foreign exchange are determined. With few exceptions, the vast bulk of foreign exchange business is done over the telephone between specialist divisions of major banks. Foreign exchange dealers in each bank usually operate from one room; each dealer has several telephones and is surrounded by video screens and news tapes. Typically, each dealer specializes in one or a small number of markets (such as sterling/dollar or deutschemark/dollar). Trades are conducted with other dealers who represent banks around the world. These dealers typically deal regularly with one another and are thus able to make firm commitments by word of mouth.

Only the head or regional offices of the larger banks actively deal in foreign exchange. The largest of these banks are known as "market makers" since they stand ready to buy or sell any of the major currencies on a more or less continuous basis. Unusually large transactions, however, will only be accommodated by market makers on more favorable terms. In such cases, foreign exchange brokers may be used as middlemen to find a taker or takers for the deal. Brokers (of which there are four major firms and a handful of smaller ones) do not trade on their own account, but specialize in setting up large foreign exchange transactions in return for a commission (typically 0.03 cents or less on the sterling spread). In April 1983, 56 percent of spot transactions by value involving banks in the United States were channeled through brokers.[4] If all interbank transactions are included, the figure rises to 59 percent.

Most small banks and local offices of major banks do not deal directly in the interbank foreign exchange market. Rather they typically will have a credit line with a large bank or their head office. Transactions will thus involve an extra step (see figure 1). The customer deals with a local bank, which in turn deals with a major bank or head office. The interbank foreign exchange market exists between the major banks either directly or indirectly via a broker.

FUTURES AND OPTION MARKETS FOR FOREIGN EXCHANGE

Until very recently, the interbank market was the only channel through which foreign exchange transactions took place. The past decade has produced major innovations in foreign exchange trading. On May 16, 1972, the International Money Market (IMM) opened under the auspices of the Chicago Mercantile Exchange. One novel feature of the IMM is that it provides a trading floor on which deals are struck by brokers face to face, rather than over telephone lines. The most significant difference between the IMM and the interbank market, however, is that trading on the IMM is in futures contracts for foreign exchange, the typical business being contracts for delivery on the third Wednesday of March, June, September or December. Activity at the IMM has expanded greatly since its opening. For example, during 1972, 144,336 contracts were traded; the figure for 1981 was 6,121,932.

There is an important distinction between "forward" transactions and "futures" contracts. The former are individual agreements between two parties, say, a bank and customer. The latter is a contract traded on an organized market of a standard size and settlement date, which is resalable at the market price up to the close of trading in the contract. These organized markets are discussed more fully below.

While the major banks conduct foreign exchange deals in large denominations, the IMM trading is done in contracts of standard size which are fairly small. Examples of the standard contracts at present are £25,000; DM125,000; Canadian $100,000. These are actually smaller today than in the early days of the IMM.

Further, unlike prices on the interbank market, price movements in any single day are subject to specific

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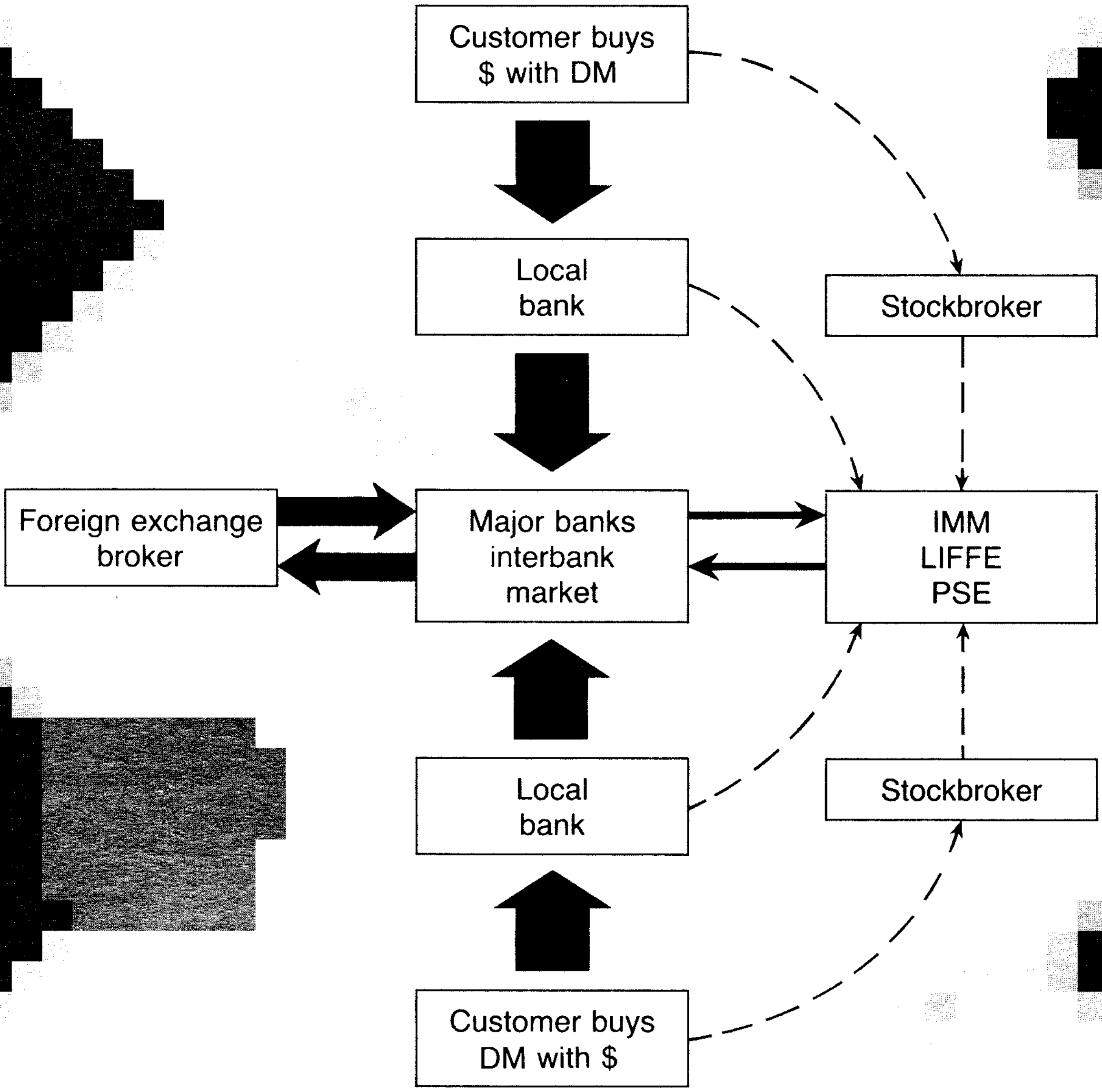
[4] See Federal Reserve Bank of New York (1983).

Figure 1
Structure of Foreign Exchange Markets


Customer buys $ with DM
Local bank
Stockbroker
Foreign exchange broker
Major banks interbank market
IMM LIFFE PSE
Local bank
Stockbroker
Customer buys DM with $

NOTE: The International Money Market (IMM) Chicago trades foreign exchange futures and DM futures options.
The London International Financial Futures Exchange (LIFFE) trades foreign exchange futures.
The Philadelphia Stock Exchange (PSE) trades foreign currency options.

limits at the IMM. For example, for sterling futures, prices are not allowed to vary more than $.0500 away from the previous day's settlement price; this limit is expanded if it is reached in the same direction for two successive days. The limit does not apply on the last day a contract is traded.

Unlike the interbank market, parties to a foreign exchange contract at the IMM typically do not know each other. Default risk, however, is minor because contracts are guaranteed by the exchange itself. To minimize the cost of this guarantee, the exchange insists upon "margin requirements" to cover fluctuations in the value of a contract. This means that an individual or firm buying a futures contract would, in effect, place a deposit equal to about 4 percent of the value of the contract.[5]

Perhaps the major limitation of the IMM from the point of view of importers or exporters is that contracts cover only eight currencies — those of Britain, Canada, West Germany, Switzerland, Japan, Mexico, France and the Netherlands — and they are specified in standard sizes for particular dates. Only by chance will these conform exactly to the needs of importers and exporters. Large firms and financial institutions will find the market useful, however, if they have a fairly continuous stream of payments and receipts in the traded foreign currencies. Although contracts have a specified standard date, they offer a fairly flexible method of avoiding exchange rate risk because they are marketable continuously.

A major economic advantage of the IMM for nonbank customers is its low transaction cost. Though the brokerage cost of a contract will vary, a "round trip" (that is, one buy and one sell) costs as little as $15. This is only .04 percent of the value of a sterling contract and less for some of the larger contracts. Of course, such costs are high compared with the interbank market, where the brokerage cost on DM 1 million would be about $6.25 (the equivalent-valued eight futures contracts would cost $60 in brokerage, taking $7.50 per single deal). They are low, however, compared with those in the retail market, where the spread may involve a cost of up to 2.5 percent or 3 percent per transaction.

A market similar to the IMM, the London International Financial Futures Exchange (LIFFE), opened in September 1982. On LIFFE, futures are traded in sterling, deutschemarks, Swiss francs and yen in identical bundles to those sold on the IMM. In its first year, the foreign exchange business of LIFFE did not take off in a big way. The major provider of exchange rate risk coverage for business continues to be the bank network. Less than 5 percent of such cover is provided by markets such as IMM and LIFFE at present.

An entirely new feature of foreign exchange markets that has arisen in the 1980s is the existence of option markets.[6] The Philadelphia Exchange was the first to introduce foreign exchange options. These are in five currencies (deutschemark, sterling, Swiss franc, yen and Canadian dollar). Trades are conducted in standard bundles half the size of the IMM futures contracts. The IMM introduced an options market in German marks on January 24, 1984; this market trades options on futures contracts whereas the Philadelphia options are for spot currencies.

Futures and options prices for foreign exchange are published daily in the financial press. Table 3 shows prices for February 14, 1984, as displayed in the *Wall Street Journal* on the following day. Futures prices on the IMM are presented for five currencies (left-hand column). There are five contracts quoted for each currency: March, June, September, December and March 1985. For each contract, opening and last settlement (settle) prices, the range over the day, the change from the previous day, the range over the life of the contract and the number of contracts outstanding with the exchange (open interest) are listed.

Consider the March and June DM futures. March futures opened at $.3653 per mark and closed at $.3706 per mark; June opened at $.3698 per mark and closed at $.3746 per mark. Turn now to the Chicago Mercantile Exchange (IMM) futures options (center column). These are options on the futures contracts just discussed (see inset for explanation of options). Thus, the line labeled "Futures" lists the settle prices of the March and June futures as above.

Let us look at the call options. These are rights to buy DM futures at specified prices — the strike price. For example, take the call option at strike price 35. This means that one can purchase an option to buy DM 125,000 March futures up to the March settlement date for $.3500 per mark. This option will cost 2.05 cents per mark, or $2,562.50, plus brokerage fees. The June option to buy June futures DM at $.3500 per mark will cost 2.46 cents per mark, or $3,075.00, plus brokerage fees.

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[5] A bank may also insist upon some minimum deposit to cover a forward contract, though there is no firm rule.

[6] For a discussion of options in commodities, see Belongia (1983).

Table 3
Futures and Options Markets

Futures Prices

Tuesday, February 14, 1984
Open Interest Reflects Previous Trading Day.

	Open	High	Low	Settle	Change	Lifetime High	Lifetime Low	Open Interest
BRITISH POUND (IMM)—25,000 pounds; $ per pound								
Mar	1.4150	1.4400	1.4150	1.4370	+ .0170	1.6010	1.3930	17,694
June	1.4175	1.4435	1.4175	1.4395	+ .0170	1.5520	1.3950	3,251
Sept	1.4285	1.4410	1.4220	1.4410	+ .0160	1.5240	1.3980	157
Dec	1.4280	1.4435	1.4245	1.4435	+ .0160	1.4650	1.3990	75
Mar85	1.4280	1.4460	1.4270	1.4470	+ .0170	1.4625	1.4000	65
Est vol 10,651; vol Mon 1,987; open int 21,242, +78.								
CANADIAN DOLLAR (IMM)—100,000 dlrs.; $ per Can $								
Mar	.8010	.8024	.8010	.8020	....	.8169	.7979	4,033
June	.8014	.8029	.8013	.8023	....	.8168	.7983	740
Sept		....	....	.8026	....	.8147	.7988	312
Dec	.8021	.8031	.8021	.8029	....	.8040	.8021	152
Mar85	.8035	.8035	.8035	.8032	....	.8035	.8023	50
Est vol 1,087; vol Mon 535; open int 5,287, −103.								
JAPANESE YEN (IMM) 12.5 million yen; $ per yen (.00)								
Mar	.4276	.4297	.4276	.4294	+ .0011	.4396	.4125	25,730
June	.4315	.4337	.4312	.4334	+ .0011	.4435	.4180	3,908
Sept	.4354	.4375	.4354	.4374	+ .0012	.4450	.4354	974
Dec	.4416	.4420	.4400	.4415	+ .0012	.4493	.4395	271
Est vol 9,133; vol Mon 3,306; open int 30,883, +534.								
SWISS FRANC (IMM)—125,000 francs; $ per franc								
Mar	.4495	.4556	.4486	.4549	+ .0047	.5230	.4470	24,164
June	.4564	.4629	.4557	.4622	+ .0051	.5045	.4536	3,165
Sept	.4632	.4692	.4632	.4688	+ .0052	.5020	.4598	153
Dec	.4705	.4780	.4705	.4747	+ .0049	.4880	.4665	71
Mar85		....	....	.4830	+ .0050	.4840	.4755	5
Est vol 30,610; vol Mon 8,466; open int 27,558, +296.								
W. GERMAN MARK (IMM)—125,000 marks; $ per mark								
Mar	.3653	.3713	.3650	.3706	+ .0036	.4100	.3537	30,974
June	.3698	3754	.3688	.3746	+ .0037	.4002	.3568	4,911
Sept	.3743	.3790	.3743	.3780	+ .0034	.4030	.3602	362
Dec	.3780	.3825	.3780	.3825	+ .0043	.3825	.3640	204
Mar85		....	....	.3838	+ .0035	.3699	.3699	1
Est vol 30,248; vol Mon 9,045; open int 36,452, +680.								

Futures Options

Chicago Mercantile Exchange

W. GERMAN MARK—125,000 marks, cents per mark

Strike Price	Calls—Settle Mar	Calls—Settle Jun	Puts—Settle Mar	Puts—Settle Jun
34	....	....	0.01	0.01
35	2.05	2.46	0.01	0.09
36	1.11	1.66	0.06	0.25
37	0.38	1.00	0.33	0.57
38	0.10	0.54	1.00	1.02
39	0.01	0.27	....	....
Futures	.3706	.3746	....	....

Estimated total vol. 2,187.
Calls: Mon vol. 180: open int. 2,416.
Puts: Mon vol. 73: open int. 1,841.

Foreign Currency Options

Philadelphia Exchange

Option & Underlying	Strike Price	Calls—Last Mar	Calls—Last Jun	Calls—Last Sep	Puts—Last Mar	Puts—Last Jun	Puts—Last Sep
12,500 British Pounds-cents per unit.							
BPound	140	3.40	r	5.70	0.40	1.85	r
143.00	.145	0.70	2.40	r	3.40	r	
50,000 Canadian Dollars-cents per unit.							
CDollar	. .80	r	r	0.68	r	r	
62,500 West German Marks-cents per unit.							
DMark	. .34	2.67	r	r	r	r	
36.88	. . .35	1.99	2.18	r	r	r	
36.88	. . .36	1.04	1.59	r	0.05	0.35	
36.88	. . .37	0.38	1.00	r	0.37	0.56	
36.88	. . .38	0.10	0.62	0.85	r	r	
36.88	. . .39	r	0.28	s	r	r	
36.88	. . .40	0.01	0.11	s	r	r	
6,250,000 Japanese Yen-100ths of a cent per unit.							
JYen	. . . 42	0.95	1.49	2.04	r	r	
42.75	. . .43	0.30	0.90	r	0.50	0.60	
42.75	. . .44	0.04	0.45	0.99	r	r	
62,500 Swiss Francs-cents per unit.							
SFranc	. .44	r	r	3.15	r	0.24	
45.18	. . .45	0.65	r	r	0.26	r	
45.18	. . .46	0.28	1.09	1.82	r	1.00	
45.18	. . .47	0.06	r	r	r	r	
45.18	. . .48	0.02	0.28	r	r	r	

Total call vol. 2,271 Call open int. 37,349
Total put vol. 799 Put open int. 26,173
r—Not traded. s—No option offered. o—Old.
Last is premium (purchase price).

Wall Street Journal, February 15, 1984

The March call option at strike price $.3900 per mark costs only 0.01 cents per mark or $12.50. These price differences indicate that the market expects the dollar price of the mark to exceed $.3500, but not to rise substantially above $.3900.

Notice that when you exercise a futures call option you buy the relevant futures contract but only fulfill that futures contract at maturity. In contrast, the Philadelphia foreign currency options (right column) are options to buy foreign exchange (spot) itself rather than futures. So, when a call option is exercised, foreign currency is obtained immediately.

The only difference in presentation of the currency option prices as compared with the futures options is that, in the former, the spot exchange rate is listed for comparison rather than the futures price. Thus, on the Philadelphia exchange, call options on March DM 62,500 at strike price $.3500 per mark cost 1.99 cents per mark or $1,243.75, plus brokerage. Brokerage fees here would be of the same order as on the IMM, about $16 per transaction round trip, per contract.

We have seen that there are several different markets for foreign exchange — spot, forward, futures, options on spot, options on futures. The channels through which these markets are formed are, however, fairly straightforward (see figure 1). The main channel is the interbank network, though for large interbank transactions, foreign exchange brokers may be used as middlemen.

FOREIGN EXCHANGE MARKET ACTIVITIES

Much foreign exchange market trading does not appear to be related to the simple basic purpose of allowing businesses to buy or sell foreign currency in order, say, to sell or purchase goods overseas. It is certainly easy to see the usefulness of the large range of foreign exchange transactions available through the interbank and organized markets (spot, forward, futures, options) to facilitate trade between nations. It is also clear that there is a useful role for foreign exchange brokers in helping to "make" the interbank market. There are several other activities, however, in foreign exchange markets that are less well understood and whose relevance is less obvious to people interested in understanding what these markets accomplish.

Foreign Exchange Options

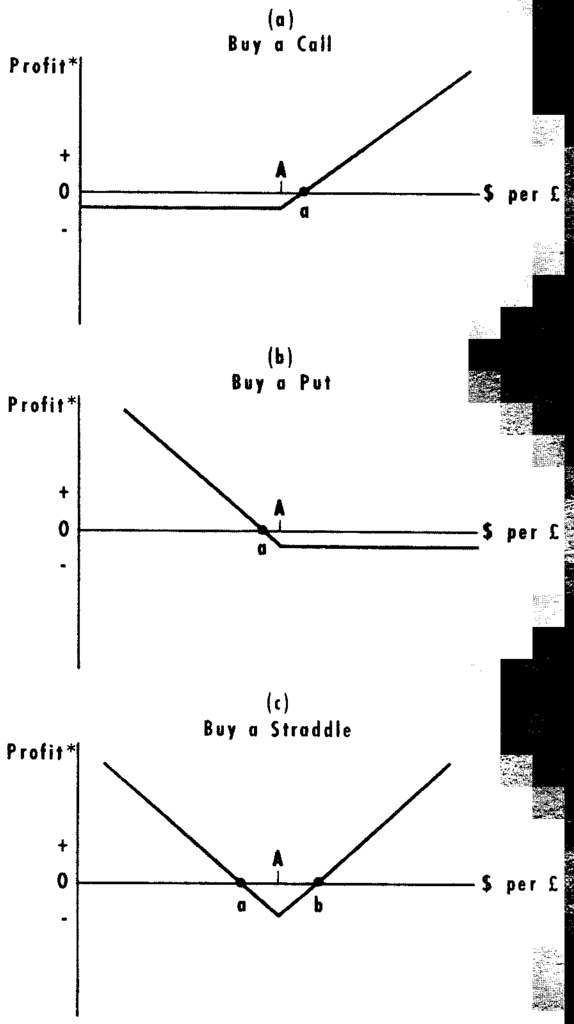
An option is a contract specifying the right to buy or sell — in this case foreign exchange — within a specific period (American option) or at a specific date (European option). A call option confers the right to buy. A put option confers the right to sell. Since each of these options must have a buyer and a seller, there are four possible ways of trading a single option: buy a call, sell a call, buy a put, sell a put.

The buyer of an option has the right to undertake the contract specified but may choose not to do so if it turns out to be unprofitable. The seller of the option *must* fulfill the contract if the buyer desires. Clearly, the buyer must pay the seller some premium (the option price) for this privilege. An option that would be profitable to exercise at the current exchange rate is said to be "in the money." The price at which it is exercised is the "exercise" or "strike" price.

Consider a call option on £1000 (although options of this size are not presently available on organized exchanges, it is used to present a simple illustration of the principles involved). Suppose this costs $0.03 per pound or $30 and the exercise price is $1.50 per pound. The option expires in three months. This means that the buyer has paid $30 for the right to buy £1000 with dollars at a price of $1.50 per pound any time in the next three months. If the current spot price of sterling is, say, $1.45, the option is "out of the money" because sterling can be bought cheaper on the spot market. However, if the spot price were to rise to, say, $1.55, the option would be in the money. If sold at that time, the option buyer would get a $50 return (1000 × $0.05), which would more than cover the cost of the option ($50 – $30 = $20 profit). In contrast, a put option at the same terms would be in the money at the current spot price of $1.45, but out of the money at $1.55.

Figure 2 presents a diagrammatic illustration of how the profitability of an option depends upon the relationship between the exercise price and the current spot price.[1] Figure 2a illustrates the profit avail-

Figure 2
Profit from Options


(a)
Buy a Call

(b)
Buy a Put

(c)
Buy a Straddle

*Profit from exercise of option at current spot exchange rate.

One simple relationship which is of interest may be called "option price parity." This arises because arbitrage will ensure that the difference between a call option price (per unit) and a put option price (per unit) at the same exercise price will be equal to the present value of the difference between the exercise price and the forward exchange rate at maturity of the options (if the options are marketable, it will also hold for any date to maturity). The relationship may be expressed:

$$C - P = \frac{F - E}{I + r},$$

when C and P are the call and put option prices at exercise price E. F is the forward exchange rate and r is the interest rate per period of the contracts. This arises because the simultaneous buying of a call and selling of a put is equivalent to buying currency forward at price E. The forward contract, however, would be paid for at the end of the period, whereas the options are transacted at the beginning. Hence, the forward contract has to be discounted back to the present.

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[1] The pricing of options has been the subject of a large theoretical literature with a major contribution being made by Black and Scholes (1973). The Black-Scholes formula has been modified for foreign exchange options by Garman and Kohlhagen (1983) [see also Giddy (1983)], but the Black-Scholes formula is complex and beyond the scope of the present paper.

able from buying a call option at exercise price A. At spot exchange rate A and anything lower, the option will not be exercised so the loss will equal the price of the option. At a spot exchange rate above a, the option is sufficiently in the money to more than cover its cost. Between A and a, the option is in the money but not by enough to cover cost. The profit from *selling* a call could be illustrated by reversing the + and − signs in figure 2a, or by flipping the profit line about the horizontal axis.

Figure 2b illustrates the profit from buying a put option. At spot exchange rates below a, the option with exercise price A will show a profit.

Figure 2c illustrates the profit from a simultaneous purchase of a put and call at the same exercise price. This combination will show a profit at exercise price A if the spot price goes *either* above b or below a. It is known as a "straddle." The straddle is of special interest because it makes clear the role of options as a hedge against risk. The price of a straddle can be regarded as the market valuation of the variability of the exchange rate. That is, the buyer of the straddle will show a profit if the spot price moves from some central value (the exercise price) by more than plus or minus some known percentage. The seller of the straddle accepts that risk for a lump sum. More complicated "multiple strategies" are also possible.[2]

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[2] See Giddy (1983).

Two major classes of activity will be discussed. First, the existence of a large number of foreign exchange markets in many locations creates opportunities to profit from "arbitrage." Second, there is implicitly a market in (foreign exchange) risk bearing. Those who wish to avoid foreign exchange risk (at a price) may do so. Those who accept the risk in expectation of profits are known as "speculators."

Triangular Arbitrage

Triangular arbitrage is the process that ensures that all exchange rates are mutually consistent. If, for example, one U.S. dollar exchanges for one Canadian dollar, and one Canadian dollar exchanges for one British pound, then the U.S. dollar-pound exchange rate should be one pound for one dollar. If it differs, then there is an opportunity for profit making. To see why this is so, suppose that you could purchase two U.S. dollars with one British pound. By first buying C$1 with U.S.$1, then purchasing £1 with C$1, and finally buying U.S.$2 with £1, you could double your money immediately. Clearly this opportunity will not last for long since it involves making large profits with certainty. The process of triangular arbitrage is exactly that of finding and exploiting profitable opportunities in such exchange rate inconsistencies. As a result of triangular arbitrage, such inconsistencies will be eliminated rapidly. Cross rates, however, will only be roughly consistent given the bid-ask spread associated with transaction costs.

In the past, the possibility of making profits from triangular arbitrage was greater as a result of the practice of expressing exchange rates in American terms in the United States and in European terms elsewhere. The adoption of standard practice has reduced the likelihood of inconsistencies.[7] Also, in recent years, such opportunities for profit making have been greatly reduced by high-speed, computerized information systems and the increased sophistication of the banks operating in the market.

Arbitrage of a slightly different kind results from price differences in different locations. This is "space" arbitrage. For example, if sterling were cheaper in London than in New York, it would be profitable to buy in London and sell in New York. Similarly, if prices in the interbank market differed from those at the IMM, it would be profitable to arbitrage between them. As a result of this activity, prices in different locations will be brought broadly into line.

Interest Arbitrage

Interest arbitrage is slightly different in nature from triangular or space arbitrage; however, the basic motive of finding and exploiting profitable opportunities still applies. There is no reason why interest rates denominated in different currencies should be equal. Interest rates are the cost of borrowing or the return to lending for a specific period of time. The relative price (exchange rate) of money may change over time so that the comparison of, say, a U.S. and a British interest rate requires some allowance for expected exchange rate changes. Thus, it will be not at all unusual to find interest rates denominated in dollars and interest rates denominated in, say, pounds being somewhat different. However, real returns on assets of similar quality should be the same if the exchange rate risk is covered or hedged in the forward market. Were this not true, it would be possible to borrow in one currency and lend in another at a profit with no exchange risk.

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[7] All except U.K. and Irish exchange rates are expressed in American terms. Futures and options contracts are expressed in European terms.

Suppose we lend one dollar for a year in the United States at an interest rate of r_{us}. The amount accumulated at the end of the year per dollar lent will be $1 + r_{us}$ (capital plus interest). If, instead of making dollar loans, we converted them into pounds and lent them in the United Kingdom at the rate r_{uk}, the amount of pounds we would have for each original dollar at the end of the year would be $S(1 + r_{uk})$, where S is the spot exchange rate (in pounds per dollar) at the beginning of the period. At the outset, it is not known if $1 + r_{us}$ dollars is going to be worth more than $S(1 + r_{uk})$ pounds in a year's time because the spot exchange rate in a year's time is unknown. This uncertainty can be avoided by selling the pounds forward into dollars. Then the relative value of the two loans would no longer depend on what subsequently happens to the spot exchange rate. By doing this, we end up with $\frac{S}{F}(1 + r_{uk})$ dollars per original dollar invested. This is known as the "covered," or hedged, return on pounds.

Since the covered return in our example is denominated in dollars, it can reasonably be compared with the U.S. interest rate. If these returns are very different, investors will move funds where the return is highest on a covered basis. This process is interest arbitrage. It is assumed that the assets involved are equally safe and, because the returns are covered, all exchange risk is avoided. Of course, if funds do move in large volume between assets or between financial centers, then interest rates and the exchange rates (spot and forward) will change in predictable ways. Funds will continue to flow between countries until there is no extra profit to be made from interest arbitrage. This will occur when the returns on both dollar- and sterling-denominated assets are equal, that is, when

$$(1) \quad (1 + r_{us}) = \frac{S}{F}(1 + r_{uk}).$$

This result is known as covered interest parity. It holds more or less exactly, subject only to a margin due to transaction costs, so long as the appropriate dollar and sterling interest rates are compared.[8]

Speculation

Arbitrage in the foreign exchange markets involves little or no risk since transactions can be completed rapidly. An alternative source of profit is available from outguessing other market participants as to what future exchange rates will be. This is called speculation. Although any foreign exchange transaction that is not entirely hedged forward has a speculative element, only deliberate speculation for profit is discussed here.

Until recently, the main foreign exchange speculators were the foreign exchange departments of banks, with a lesser role being played by portfolio managers of other financial institutions and international corporations. The IMM, however, has made it much easier for individuals and smaller businesses to speculate. A high proportion of IMM transactions appears to be speculative in the sense that only about 5 percent of contracts lead to ultimate delivery of foreign exchange. This means that most of the activity involves the buying and selling of a contract *at different times* and possibly different prices prior to maturity. It is possible, however, that buying and selling of contracts before maturity would arise out of a strategy to reduce risk. So it is not possible to say that all such activity is speculative.

Speculation is important for the efficient working of foreign exchange markets. It is a form of arbitrage that occurs across time rather than across space or between markets at the same time. Just as arbitrage increases the efficiency of markets by keeping prices consistent, so speculation increases the efficiency of forward, futures and options markets by keeping those markets liquid. Those who wish to avoid foreign exchange risk may thereby do so in a well-developed market. Without speculators, risk avoidance in foreign exchange markets would be more difficult and, in many cases, impossible.[9]

Risk Reduction

Speculation clearly involves a shifting of risk from one party to another. For example, if a bank buys for-

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[8] Since there are many different interest rates, it obviously cannot hold for all of them. Where (1) does hold is if the interest rates chosen are eurocurrency deposit rates of the same duration. In other words, if for r_{us} we take, say, the three-month eurodollar deposit rate in Paris and for r_{uk} we take the three-month eurosterling deposit rate in Paris, then (1) will hold just about exactly. Indeed, if we took the interest rate and exchange rate quotes all from the same bank, it would be remarkable if (1) did not hold. Otherwise the bank would be offering to pay you to borrow from it and lend straight back! That is, the price of borrowing would be less than the covered return on lending. A margin between borrowing and lending rates, of course, will make this even less likely so that in reality you would lose.

[9] This is not to say that all speculative activity is necessarily beneficial.

Covered Interest Parity: An Example

The following interest rate and exchange rate quotations are taken from the *London Financial Times* of September 8, 1983 (table 1).

Closing Exchange Rate: dollars per pound	Spot	3-Month Forward
	1.4910–1.4920	.17–.22 discount
Interest Rates: 3-Month Offer Rate	**Eurosterling**	**Eurodollar**
	$9\frac{13}{16}$	$10\frac{1}{4}$

The interest rate on the three-month eurodollar deposit is a little higher (.7 percent) than that on an eurosterling deposit. If the exchange rate remains unchanged, it would be better to hold dollars; if the exchange rate falls, the eurosterling deposit would be preferable. Suppose you decide to cover the exchange risk by selling the dollars forward into pounds. Let us compare the return to holding a sterling deposit with the return to holding a dollar deposit sold forward into sterling (assuming that you start with sterling).

Two important points need to be clarified about the above data. First, the interest rates are annualized so they are not what would actually be earned over a three-month period. For example, the three-month rate equivalent to an annual rate of $10\frac{1}{4}$ percent is 2.47 percent.

Second, the forward exchange rates need some explanation. The dollar is at a discount against sterling. This means the forward dollar buys less sterling. So we have to *add* the discount onto the spot price to get the forward price (because the price is the number of dollars per pound, not the reverse). Notice also that the discount is measured in fractions of a cent, not fractions of a dollar! So the bid-ask spread on the forward rate would be 1.4927 – 1.4942.

Now let us see if we would do better to invest in a three-month eurosterling deposit or a three-month eurodollar deposit where the dollars to be received were sold forward into sterling. The return per £100 invested in eurosterling is £2.369 (annual interest rate of $9\frac{13}{16}$), whereas the return on a covered eurodollar deposit is

$$£2.251 = (100 \times \frac{1.4910}{1.4942} 1.0247) - 100.$$

Thus, we could not make a profit out of covered interest arbitrage. Despite the fact that dollar interest rates are higher, the discount on forward dollars in the forward market means they buy fewer forward pounds. As a result, there is no benefit to the operation. Transaction costs for most individuals would be even greater than those above as they would face a larger bid-ask spread than that quoted on the interbank market.

Consequently, there is no benefit for the typical investor from making a covered or hedged eurocurrency deposit. The return will be at least as high on a deposit in the currency in which you start and wish to end up. That is, if you have dollars and wish to end up with dollars, make a eurodollar deposit. If you have sterling and wish to end up with sterling, make a eurosterling deposit. If you have sterling and wish to end up in dollars, there is likely to be little or no difference between holding a eurosterling deposit sold forward into dollars or buying dollars spot and holding a eurodollar deposit. Of course, if you hold an "uncovered" deposit and exchange rates subsequently change, the result will be very different.

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ward foreign exchange from a customer, it increases its exposure to risk while the customer reduces his. However, there is not a fixed amount of risk that has to be "shared out." Some strategies may involve a net reduction of risk all around.

As a general rule, financial institutions (or other firms), operating in a variety of currencies, will try to minimize the risk of losses due to unexpected exchange rate changes. One simple way to do this is to ensure that assets and liabilities denominated in each operating currency are equal. This is known as "matching." For example, a bank that sells sterling forward to a customer may simultaneously buy sterling forward. In this event, the bank is exposed to zero exchange rate risk.

Why Is the Dollar the "Money" of Foreign Exchange Markets?

One interesting aspect of the organization of the foreign exchange markets is that the "money" used in these markets is generally the U.S. dollar. This is generally true for spot markets and universally true for forward markets. "Cross-markets" between many currencies are very thin, and future cross markets are virtually nonexistent. For example, the bulk of foreign exchange trading between £s and cruzeiro will involve dollar-£ and dollar-cruzeiro transactions instead of direct £-cruzeiro trading. The only exception to this is the transactions involving the major Organization for Economic Cooperation and Development (OECD) currencies, especially within Europe. Of the $702.5 billion turnover in foreign exchange reported by U.S. banks in April 1983, only $1.5 billion did not involve U.S. dollars.

There are two explanations for this special role of the dollar in foreign exchange markets. Both rely upon the fact that transaction costs are likely to be lower if the dollar is used as a medium. Krugman shows that the clearing of foreign exchange markets requires some "intermediary" currency.[1] Even if every country is in payments balance vis a vis the rest of the world, it will not necessarily be in bilateral balance with each other country. Because some currency has to be used to cover this residual finance, it is natural to choose the currency that has the lowest transaction costs. Chrystal shows there are economic reasons why cross-markets between many currencies do not exist.[2] It typically will be easier and cheaper to set up a deal in two steps via the dollar than in a single step (cruzeiro-dollar, dollar-drachma rather than cruzeiro-drachma). This is because these cross-markets, if they existed, would be fairly thin and hence relatively costly for such transactions. The two markets with the dollar, on the other hand, are well developed.

These analyses refer to the role of the dollar in the interbank market. In the development of the trading places such as the IMM in Chicago and LIFFE in London to date, it is also true that all currency futures are traded against the dollar.

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[1] See Krugman (1980).

[2] See Chrystal (1982).

Banks often use "swaps" to close gaps in the maturity structure of their assets and liabilities in a currency. This involves the simultaneous purchase and sale of a currency for *different* maturity dates. In April 1983, 33 percent of U.S. banks' foreign exchange turnover involved swaps as compared with 63 percent spot contracts and only 4 percent outright forward contracts.[10]

Suppose a bank has sold DM to a customer three months forward and bought the same amount of DM from a different customer six months forward. There are two ways in which the bank could achieve zero foreign exchange risk exposure. It could either undertake two separate offsetting forward transactions, or it could set up a single swap with another bank that has the opposite mismatch of dollar-DM flows whereby it receives DM in exchange for dollars in three months and receives back dollars in exchange for DM in six months. Once the swap is set up, the bank's net profits are protected against subsequent changes in spot exchange rates during the next six months.

Within the limits imposed by the nature of the contracts, a similar effect can be achieved by an appropriate portfolio of futures contracts on the IMM. Thus, a bank would buy and sell futures contracts so as to match closely its forward commitments to customers. In reality, banks will use a combination of methods to reduce foreign exchange risk.

Markets that permit banks, firms and individuals to hedge foreign exchange risk are essential in times of fluctuating exchange rates. This is especially important for banks if they are to be able to provide efficient foreign exchange services for their customers. In the absence of markets that permit foreign exchange risk hedging, the cost and uncertainty of international transactions would be greatly increased, and international specialization and trade would be greatly reduced.

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[10] See Federal Reserve Bank of New York (1983).

CONCLUSION

The foreign exchange markets are complex and, for the outsider, hard to comprehend. The primary function of these markets is straightforward. It is to facilitate international transactions related to trade, travel or investment. Foreign exchange markets can now accommodate a large range of current and forward transactions.

Given the variability of exchange rates, it is important for banks and firms operating in foreign currencies to be able to reduce exchange rate risk whenever possible. Some risk reduction is achieved by interbank swaps, but some is also taken up by speculation. Arbitrage and speculation both increase the efficiency of spot and forward foreign exchange markets and have enabled foreign exchange markets to achieve a high level of efficiency. Without the successful operation of these markets, the obstacles to international trade and investment would be substantial and the world would be a poorer place.

Glossary

American option — an option that can be exercised any time up to maturity.

American terms — an exchange rate expressed as number of currency units per dollar.

arbitrage — the simultaneous purchase and sale of currency in separate markets for a profit arising from a price discrepancy between the markets.

bid-ask spread — the difference between the buying (bid) and selling (ask) price.

covered interest arbitrage — buying a country's currency spot, investing for a period, and selling the proceeds forward in order to make a net profit due to the higher interest rate in that country. This act involves "hedging" because it guarantees a covered return without risk. The opportunities to profit in this way seldom arise because covered interest differentials are normally close to zero.

covered interest parity — the gap between interest rates in foreign and domestic currencies will be matched by the forward exchange rate differential, such that the "covered" interest rate differential will be close to zero.

eurodollar deposits — bank deposits, generally bearing interest and made for a specific time period, that are denominated in dollars but are in banks outside the United States. Similarly, eurosterling deposits would be denominated in sterling but outside the United Kingdom.

European option — an option that can be exercised only on a specified date.

European terms — an exchange rate expressed as number of dollars per currency unit.

floating exchange rate — an exchange rate that is allowed to adjust freely to the supply of and demand for foreign exchange.

foreign exchange speculation — the act of taking a net position in a foreign currency with the intention of making a profit from exchange rate changes.

forward exchange rate — the price of foreign currency for delivery at a future date agreed to by a contract today.

futures market — a market in which contracts are traded to buy or sell a standard amount of currency in the future at a particular price.

hedging — or covering exchange risk, means that foreign currency is sold forward into local currency so that its value is not affected by subsequent exchange rate changes. Say an exporter knows he will be paid £10,000 in two months. He can wait until he gets the money and convert it into dollars at whatever the spot rate turns out to be. This outcome is uncertain as the spot rate may change. Alternatively, he can sell £10,000 two months forward at today's two-month forward price. Suppose this is $1.5 per £. In two months, he will receive £10,000, fulfill his forward contract and receive $15,000. This export contract has been hedged or covered in the forward market.

matching — equating assets and liabilities denominated in each currency so that losses due to foreign exchange rate changes are minimized.

options market — a market in which contracts are traded that gives a purchaser the right but no obligation to buy (call) or to sell (put) a currency in the future at a given price.

spot exchange rate — the price paid to exchange currencies for immediate delivery (two business days in the interbank market, or over the counter in the retail and travelers check market).

swap — the simultaneous purchase and sale of a currency for different maturity dates that closes the gaps in the maturity structure of assets and liabilities in a currency.

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